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Citation for published version:

Papalampidi, P, Keller, F & Lapata, M 2019, Movie Plot Analysis via Turning Point Identification. in *Proceedings of the Conference on Empirical Methods in Natural Language Processing and 9th International Joint Conference on NLP*. Association for Computational Linguistics (ACL), pp. 1707–1717, 2019
Conference on Empirical Methods in Natural Language Processing and 9th International Joint Conference on Natural Language Processing, Hong Kong, Hong Kong, 3/11/19. <https://doi.org/10.18653/v1/D19-1180>

Digital Object Identifier (DOI):

[10.18653/v1/D19-1180](https://doi.org/10.18653/v1/D19-1180)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Proceedings of the Conference on Empirical Methods in Natural Language Processing and 9th International Joint Conference on NLP

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Movie Plot Analysis via Turning Point Identification

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Abstract

According to screenwriting theory, turning points (e.g., change of plans, major setback, climax) are crucial narrative moments within a screenplay: they define the plot structure, determine its progression and thematic units (e.g., setup, complications, aftermath). We propose the task of turning point identification in movies as a means of analyzing their narrative structure. We argue that turning points and the segmentation they provide can facilitate processing long, complex narratives, such as screenplays, for summarization and question answering. We introduce a dataset consisting of screenplays and plot synopses annotated with turning points and present an end-to-end neural network model that identifies turning points in plot synopses and projects them onto scenes in screenplays. Our model outperforms strong baselines based on state-of-the-art sentence representations and the expected position of turning points.

1 Introduction

Computational literary analysis works at the intersection of natural language processing and literary studies, aiming to evaluate various theories of storytelling (e.g., by examining a collection of works within a single genre, by an author, or topic) and to develop tools which aid in searching, visualizing, or summarizing literary content.

Within natural language processing, computational literary analysis has mostly targeted works of fiction such as novels, plays, and screenplays. Examples include analyzing characters, their relationships, and emotional trajectories (Chaturvedi et al., 2017; Iyyer et al., 2016; Elsner, 2012), identifying enemies and allies (Nalisnick and Baird, 2013), villains or heroes (Bamman et al., 2014, 2013), measuring the memorability of quotes (Danescu-Niculescu-Mizil et al., 2012), characterizing gender representation in dialogue (Agarwal et al., 2015; Ramakrishna et al., 2015; Sap et al., 2017), identifying perpetrators in crime se-

Turning Point	Description
1. Opportunity	Introductory event that occurs after the presentation of the setting and the background of the main characters.
2. Change of Plans	Event where the main goal of the story is defined. From this point on, the action begins to increase.
3. Point of No Return	Event that pushes the main character(s) to fully commit to their goal.
4. Major Setback	Event where everything falls apart (temporarily or permanently).
5. Climax	Final event of the main story, moment of resolution and the “biggest spoiler”.

Table 1: Turning points and their definitions.

ries (Frermann et al., 2018), summarizing screenplays (Gorinski and Lapata, 2018), and answering questions about long and complex narratives (Kočiský et al., 2018).

In this paper we are interested in the automatic analysis of narrative structure in screenplays. Narrative structure, also referred to as a storyline or plotline, describes the framework of how one tells a story and has its origins to Aristotle who defined the basic triangle-shaped plot structure representing the beginning (protasis), middle (epitasis), and end (catastrophe) of a story (Pavis, 1998). The German novelist and playwright Gustav Freytag modified Aristotle’s structure by transforming the triangle into a pyramid (Freytag, 1896). In his scheme, there are five acts (*introduction*, *rising movement*, *climax*, *return*, and *catastrophe*). Several variations of Freytag’s pyramid are used today in film analysis and screenwriting (Cutting, 2016).

In this work, we adopt a variant commonly employed by screenwriters as a practical guide for producing successful screenplays (Hague, 2017). According to this scheme, there are six stages (acts) in a film, namely *the setup*, *the new situation*, *progress*, *complications and higher stakes*, *the final push*, and *the aftermath*, separated by five *turning points* (TPs). TPs are narrative moments from which the plot goes in a different direction

Recently divorced Meg Altman and her 11-year-old daughter Sarah have just purchased a four-story brownstone on New York City. The house's previous owner installed an isolated room used to protect the house's occupants from intruders. **On the night the two move into the home, it is broken by Junior, the previous owner's grandson; Burnham, an employee of the residence's security company; and Raoul; a ski mask-wearing gunman.**

The three are after \$3 million in bearer bonds, which are locked inside a floor safe in the panic room.... As they begin the robbery, Meg wakes up and happens to see the intruders on the video monitors in the panic room. **Before the three can reach them, Meg and Sarah run into the panic room and close the door behind them, only to find that the burglars have disabled the telephone.**

Intending to force them out of the room, Burnham introduces propane gas into the room's air vents.... Meg then taps into the main telephone line and gets through to her ex-husband Stephen, before the burglars cut them off.... Stephen arrives at the home and is taken hostage by Burnham and Raoul—who severely beats him. **To make matters worse, Sarah, who has diabetes, suffers a seizure.**

Her glucagon syringe is in a refrigerator outside the panic room. After using an unconscious Stephen to trick Meg into momentarily leaving the panic room, Burnham enters it, finding Sarah motionless on the floor.... After Burnham gives Sarah the injection, Sarah thanks him. Having earlier received a call from Stephen, two policemen arrive, which prompts Raoul to threaten Sarah's life. **Sensing the potential danger to her daughter, Meg lies to the officers and they leave.**

Meanwhile, Burnham opens the safe and removes the \$22 million in bearer bonds inside. As the robbers attempt to leave, using Sarah as a hostage, Meg hits Raoul with a sledgehammer and Burnham flees. **After a badly injured Stephen shoots at Raoul and misses, Raoul disables him and prepares to kill Meg with the sledgehammer, but Burnham, upon hearing Sarah's screams of pain, returns to the house and shoots Raoul dead, stating, "You'll be okay now", to Meg and her daughter before leaving.**

The police, alerted by Meg's suspicious behavior earlier, arrive in force and capture Burnham. Later, Meg and Sarah, having recovered from their harrowing experience, begin searching the newspaper for a new home.

Figure 1: Example of turning point annotations (TP1, TP2, TP3, TP4, TP5, respectively) for the synopsis of the movie “Panic Room”.

(Thompson, 1999), and by definition they occur at the junctions of acts. Aside from changing narrative direction, TPs define the movie’s structure, tighten the pace, and prevent the narrative from drifting. The five TPs and their definitions are given in Table 1.

We propose the task of turning point identification in movies as a means of analyzing their narrative structure. TP identification provides a sequence of key events in the story and segments the screenplay into thematic units. Common approaches to summarization and QA of long or multiple documents (Chen et al., 2017; Yang et al., 2018; Kratzwald and Feuerriegel, 2018; Elgohary et al., 2018) include a retrieval system as the first step, which selects a subset of relevant passages for further processing. However, Kočiský et al. (2018) demonstrate that these approaches do not perform equally well for extended narratives, since individual passages are very similar and the same entities are referred to throughout the story. We argue that this challenge can be addressed by TP identification, which finds the most important events and segments the narrative into thematic units. Downstream processing for summarization or question answering can then focus on those segments that are relevant to the task.

Problematically for modeling purposes, TPs are latent in screenplays, there are no scriptwriting conventions (like character cues or scene headings) to denote where TPs occur, and their exact

manifestation varies across movies (depending on genre and length), although there are some rules of thumb indicating where to expect a TP (e.g., the Opportunity occurs after the first 10% of a screenplay, Change of Plans is approximately 25% in). To enable automatic TP identification, we develop a new dataset which consists of screenplays, plot synopses, and turning point annotations. To save annotation time and render the labeling task feasible, we collect TP annotations at the plot synopsis level (synopses are a few paragraphs long compared to screenplays which are on average 120 pages long). An example is given in Figure 1. We then project the TP annotations via distant supervision onto screenplays and propose an end-to-end neural network model which identifies TPs in full length screenplays.

Our contributions can be summarized as follows: (a) we introduce TP identification as a new task for the computational analysis of screenplays that can benefit applications such as QA and summarization; (b) we create and make publicly available the **TuRnIng POint Dataset (TRI-POD)**¹ which contains 99 movies (3,329 synopsis sentences and 13,403 screenplay scenes) annotated with TPs; and (c) we present an end-to-end neural network model that identifies turning points in plot synopses and projects them onto scenes in screenplays, outperforming strong baselines based on state-of-the-art sentence representations and the expected position of TPs.

2 Related Work

Recent years have seen increased interest in the automatic analysis of long and complex narratives. Specifically, Machine Reading Comprehension (MRC) and Question Answering (QA) tasks are transitioning from investigating single short and clean articles or queries (Rajpurkar et al., 2016; Nguyen et al., 2016; Trischler et al., 2016) to large scale datasets that consist of complex stories (Tapaswi et al., 2016; Frermann et al., 2018; Kočiský et al., 2018; Joshi et al., 2017) or require reasoning across multiple documents (Welbl et al., 2018; Wang et al., 2018; Dua et al., 2019; Yang et al., 2018). Tapaswi et al. (2016) introduce a multi-modal dataset consisting of questions over 140 movies, while Frermann et al. (2018) attempt to answer a single question, namely who is the perpetrator in 39 episodes of the well-known crime series CSI, again based on multi-modal informa-

¹<https://github.com/ppapalampidi/TRIPOD>

tion. Finally, Kočiský et al. (2018) recently introduced a dataset consisting of question-answer pairs over 1,572 movie screenplays and books.

Previous approaches have focused on fine-grained story analysis, such as inducing character types (Bamman et al., 2013, 2014) or understanding relationships between characters (Iyyer et al., 2016; Chaturvedi et al., 2017). Various approaches have also attempted to analyze the goal and structure of narratives. Black and Wilensky (1979) evaluate the functionality of story grammars in story understanding, Elson and McKeown (2009) develop a platform for representing and reasoning over narratives, and Chambers and Jurafsky (2009) learn fine-grained chains of events.

In the context of movie summarization, Gorinski and Lapata (2018) automatically generate an overview of the movie’s genre, mood, and artistic style based on screenplay analysis. Gorinski and Lapata (2015) summarize full length screenplays by extracting an optimal chain of scenes via a graph-based approach centered around the characters of the movie. A similar approach has also been adopted by Vicol et al. (2018), who introduce the MovieGraphs dataset consisting of 51 movies and describe video clips with character-centered graphs. Other work creates animated story-boards using the action descriptions of screenplays (Ye and Baldwin, 2008), extracts social networks from screenplays (Agarwal et al., 2014a), or creates *xkcd* movie narrative charts (Agarwal et al., 2014b).

Our work also aims to analyze the narrative structure of movies, but we adopt a high-level approach. We advocate TP identification as a precursor to more fine-grained analysis that unveils character attributes and their relationships. Our approach identifies key narrative events and segments the screenplay accordingly; we argue that this type of preprocessing is useful for applications which might perform question answering and summarization over screenplays. Although our experiments focus solely on the textual modality, turning point analysis is also relevant for multimodal tasks such as trailer generation and video summarization.

3 The TRIPOD Dataset

The TRIPOD dataset contains 99 screenplays, accompanied with cast information (according to IMDb), and Wikipedia plot synopses annotated with turning points. The movies were selected from the Scriptbase dataset (Gorinski and Lapata,

	Train	Test
movies	84	15
turning points	420	75
synopsis sentences	2,821	508
screenplay scenes	11,320	2,083
synopsis vocabulary	7.9k	2.8k
screenplay vocabulary	37.8k	16.8k
<i>per synopsis</i>		
tokens	729.8 (165.5)	698.4 (187.4)
sentences	35.4 (8.4)	33.9 (9.9)
sentence tokens	20.6 (9.5)	20.6 (9.3)
<i>per screenplay</i>		
tokens	23.0k (6.6)	20.9k (4.5)
sentences	3.0k (0.9)	2.8k (0.6)
scenes	133.0 (61.1)	138.9 (50.7)
<i>per scene</i>		
tokens	173.0 (235.0)	150.5 (198.3)
sentences	22.2 (31.5)	19.9 (26.9)
sentence tokens	7.8 (6.0)	7.6 (6.4)

Table 2: Statistics of the TRIPOD dataset; all means are shown with standard deviation in brackets.

2015) based on the following criteria: (a) maintaining a variation across different movie genres (e.g., action, romance, comedy, drama) and narrative types (e.g., flashbacks, time shifts); and (b) including screenplays that are faithful to the released movies and their synopses as much as possible. In Table 2, we present various statistics of the dataset.

Our motivation for obtaining TP annotations at the synopsis level (coarse-grained), instead of at the screenplay level (fine-grained) was twofold. Firstly, on account of being relatively short, synopses are easier to annotate than full-length screenplays, allowing us to scale the dataset in the future. Secondly, we would expect synopsis-level annotations to be more reliable and the degree of inter-annotator agreement higher; asking annotators to identify precisely where a turning point occurs might seem like looking for a needle in a haystack. An example of a synopsis with TP annotations is shown in Figure 1 for the movie “Panic Room”. Each TP is colored differently, and both the chain of key events (colored text) and resulting segmentation (∞) are illustrated.

In an initial pilot study, the three authors acted as annotators for identifying TPs in movie synopses. They selected exactly one sentence per TP, under the assumption that all TPs are present. Based on the pilot, annotation instructions were devised and an annotation tool was created which allows to label synopses with TPs sentence-by-sentence. After piloting the annotation scheme on 30 movies, two new annotators were trained using our instructions and in a second study, they doubly annotated five movies. The remaining movies

in the dataset were then single annotated by the new annotators.

We computed inter-annotator agreement using two different metrics: (a) total agreement (TA), i.e., the percentage of TPs that two annotators agree upon by selecting the exact same sentence; and (b) annotation distance, i.e., the distance $d[p_i, tp_i]$ between two annotations for a given TP, normalized by synopsis length:

$$d[p_i, tp_i] = \frac{1}{N} |p_i - tp_i| \quad (1)$$

where N is the number of synopsis sentences and tp_i and p_i are the indices of the sentences labeled with TP i by two annotators. The mean annotation distance D is then computed by averaging distances $d[p_i, tp_i]$ across all annotated TPs.

The TA between the two annotators in our second study was 64.00% and the mean annotation distance was 4.30% (StDev 3.43%). The annotation distance per TP is presented in Table 5 (last line), where it is compared with the automatic TP identification results (to be explained later).

We also asked our annotators to annotate the screenplays (rather than synopses) for a subset of 15 movies. This subset serves as our goldstandard test set. Annotators were given synopses annotated with TPs and were instructed to indicate for each TP which scenes in the screenplay correspond to it. Six of the 15 movies were doubly annotated, so that we could measure agreement. Since annotators were allowed to choose a variable number of scenes for each TP, this changes slightly our agreement metrics.

Total Agreement (TA) now is the percentage of TP scenes the annotators agree on:

$$TA = \frac{1}{T \cdot L} \sum_{i=1}^{T \cdot L} \frac{|S_i \cap G_i|}{|S_i \cup G_i|} \quad (2)$$

where T , L are the TPs identified per annotator in a screenplay, and S_i and G_i are the indices of the scenes selected for TP i by the two annotators. Partial Agreement (PA) is the percentage of TPs where there is an overlap of at least one scene:

$$PA = \frac{1}{T \cdot L} \sum_{i=1}^{T \cdot L} [S_i \cap G_i \neq \emptyset] \quad (3)$$

And annotation distance D becomes the mean of the distances² $d[S_i, G_i]$ between two annotators

²We compute the minimum distance between the two sets of scenes, since non-sequential scenes may be included in the same set. Hence, considering the center of the sets is not always representative of the TP scenes.

normalized by M , the length of the screenplay:

$$d[S_i, G_i] = \frac{1}{M} \min_{(s \in S_i, g \in G_i)} |s - g| \quad (4)$$

The TA and PA between the two annotators were 35.48% and 56.67%, respectively. The mean annotation distance was 1.48% (StDev 2.93%). The TA shows that the annotators rarely indicate the same scenes, even if they are asked to annotate an event in the screenplay that is described by a specific synopsis sentence. However, they identify scenes which are in close proximity in the screenplay, as PA and annotation distance reveal. This analysis validates our assumption that annotating the synopses first limits the degree of overall disagreement.

4 Turning Point Prediction Models

In this work, we aim to detect text segments which act as TPs. We first identify which *sentences* in plot synopses are TPs (Section 4.1); next, we identify which *scenes* in screenplays act as TPs via projection of *goldstandard* TP labels (Section 4.2); finally, we build an end-to-end system which identifies TPs in screenplays based on *predicted* TP synopsis labels (Section 4.3).

All models we propose in this paper have the same basic structure; they take text segments i (sentences or scenes) as input and predict whether these act as TPs or not. Since the sequence, number, and labels of TPs are fixed (see Table 1), we treat TP identification as a binary classification problem (where 1 indicates that the text is a TP and 0 otherwise). Each segment is encoded into a multi-dimensional feature space x_i which serves as input to a fully-connected layer with a single neuron representing the probability that i acts as a TP. In the following, we describe several models which vary in the way input segments are encoded.

4.1 Identifying Turning Points in Synopses

Context-Aware Model (CAM) A simple baseline model would compute the semantic representation of each sentence in the synopsis using a pre-trained sentence encoder. However, classifying segments in isolation without considering the context in which they appear, might yield inferior semantic representations. We therefore obtain richer representations for sentences by modeling their surrounding context. We encode the synopsis with a Bidirectional Long Short-Term Memory (BiLSTM; Hochreiter and Schmidhuber 1997) network; and obtain contextualized representation cp_i

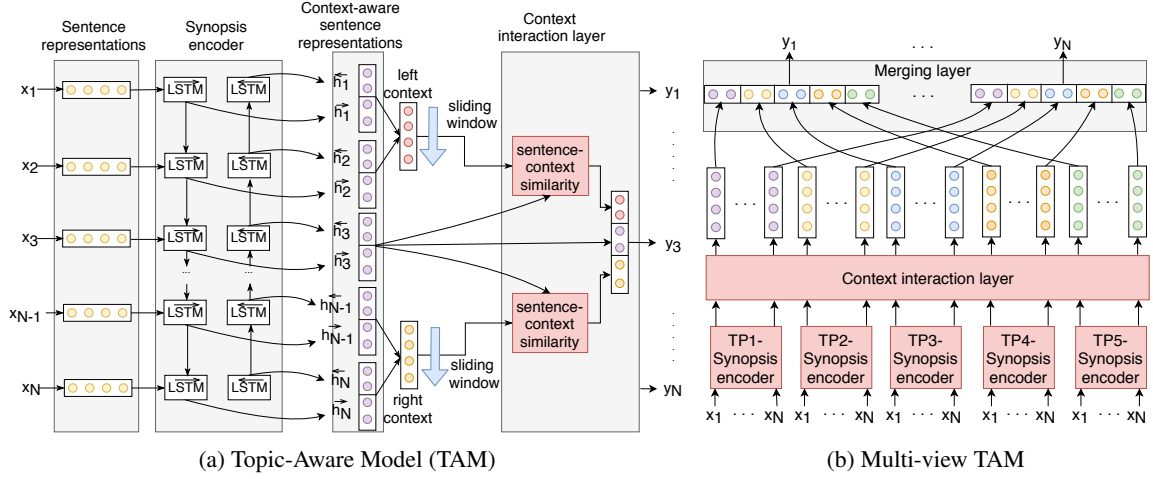


Figure 2: Model overview for TP identification in synopses. On the left, sentence representations x_i are contextualized via a synopsis encoder (BiLSTM layer) and after interacting with the left and right windows in the context interaction layer, the final sentence representation y_i is computed. On the right, five different synopsis encoders are utilized, one per TP, and these different views of a synopsis sentence x_i are combined in the merging layer.

for sentence x_i by concatenating the hidden layers of the forward \vec{h}_i and backward \overleftarrow{h}_i LSTM, respectively: $cp_i = h_i = [\vec{h}_i; \overleftarrow{h}_i]$ (for a more detailed description, see the Appendix). Representation cp_i is the input feature vector for our binary classifier. The model is illustrated in Figure 2a.

Topic-Aware Model (TAM) TPs by definition act as boundaries between different thematic units in a movie. Furthermore, long documents are usually comprised of topically coherent text segments, each of which contains a number of text passages such as sentences or paragraphs (Salton et al., 1996). Inspired by text segmentation approaches (Hearst, 1997) which measure the semantic similarity between sequential context windows in order to determine topic boundaries, we enhance our representations with a *context interaction* layer. The objective of this layer is to measure the similarity of the current sentence with its preceding and following context, thereby encoding whether it functions as a boundary between thematic sections. The enriched model with the context interaction layer is illustrated in Figure 2a.

After calculating contextualized sentence representations cp_i , we compute the representation of the left lc_i and right rc_i contexts of sentence i (see Figure 2a, right-hand side). We select windows of fixed length l and calculate lc_i and rc_i by averaging the sentence representations within each window. Next, we compute the semantic similarity of the current sentence with each context representation. Specifically, we consider the element-wise product b_i , cosine similarity c_i and pairwise distance u_i

as similarity metrics:

$$b_i = cp_i \odot lc_i \quad c_i = \frac{cp_i \cdot lc_i}{\|cp_i\| \|lc_i\|} \quad (5)$$

$$u_i = \frac{cp_i \cdot lc_i}{\max(\|cp_i\|_2, \|lc_i\|_2)} \quad (6)$$

The interaction representation of sentence cp_i with its left context is the concatenation of cp_i , fl_i , and the above similarity values (i.e., b_i, c_i, u_i):

$$fl_i = [cp_i; lc_i; b_i; c_i; u_i] \quad (7)$$

The interaction representation fr_i for the right context rc_i is computed analogously. We obtain the final representation of sentence i via concatenating fl_i and fr_i : $y_i = [fl_i; fr_i; cp_i]$.

TP-Specific Information Another variation of our model is to use TP-specific encoders instead of a single one (see Figure 2b). In this case, we employ five different encoders for calculating five different representations for the current synopsis sentence x_i , each one with respect to a specific TP. These representations can be considered multiple views of the same sentence. We calculate the interaction of each view with the left and right context window, as previously, via the context interaction layer. Finally we compute the sentence representation y_i by concatenating its individual context-enriched TP representations.

Entity-Specific Information We also enrich our model with information about entities. We first apply co-reference resolution to the plot synopses using the Stanford CoreNLP toolkit (Manning et al.,

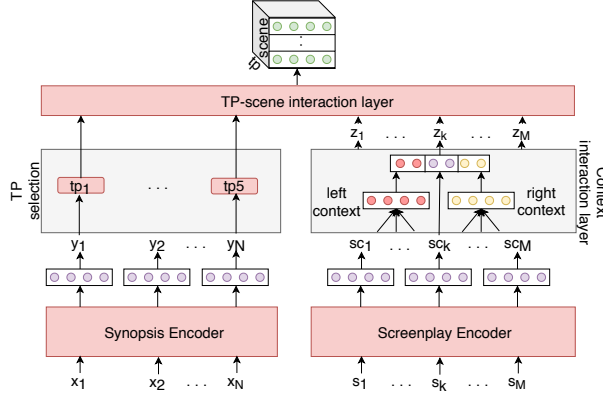


Figure 3: TAM overview for TP identification in screenplays. The synopsis and screenplay encoders contextualize synopsis sentences x_i and screenplay scenes s_i , respectively. TPs are selected from contextualized synopsis sentences y_i and a richer representation sc_i is computed for s_i via the context interaction layer. The similarity between sentence tp_i and scene z_i is computed by the TP–scene interaction layer.

2014) and substitute mentions of named entities whenever these are included in the IMDb cast list. We then obtain entity-specific sentence representations as follows. Our encoder uses a word embedding layer initialized with pre-trained entity embeddings and a BiLSTM for contextualizing word representations. We add an attention mechanism on top of the LSTM, which assigns a weight to each word representation. We compute the entity-specific representation e_i for synopsis sentence i as the weighted sum of its word representations (for more details, see the Appendix). Finally, entity enriched sentence representations x'_i are obtained by concatenating generic vectors x_i with entity-specific ones e_i : $x'_i = [x_i; e_i]$.

4.2 Identifying Turning Points in Screenplays

Identifying TPs in synopses serves as a testbed for validating some of the assumptions put forward in this work, namely that turning points mark narrative progression and can be identified automatically based on their lexical makeup. Nevertheless, we are mainly interested in the real-world scenario where TPs are detected in longer documents such as screenplays. Screenplays are naturally segmented into scenes, which often describe a self-contained event that takes place in one location, and revolves around a few characters. We therefore assume that scenes are suitable textual segments for signaling TPs in screenplays.

Unfortunately, we do not have any goldstandard information about TPs in screenplays. We pro-

	TP1	TP2	TP3	TP4	TP5
theory	10.00	25.00	50.00	75.00	94.50
μ	11.39	31.86	50.65	74.15	89.43
σ	6.72	11.26	12.15	8.40	4.74

Table 3: Expected TP position based on screenwriting theory; mean position μ and standard deviation σ in goldstandard synopses of our training set.

vide distant supervision by constructing noisy labels based on goldstandard TP annotations in synopses (see the description below). Given sentences labeled as TPs in a synopsis, we identify scenes in the corresponding screenplay which are semantically similar to them. We formulate this task as a binary classification problem, where a sentence-scene pair is deemed either “relevant” or “irrelevant” for a given TP.

Distant Supervision Based on the screenwriting scheme of Hague (2017), TPs are expected to occur in specific parts of a screenplay (e.g., the Climax is likely to occur towards the end). We exploit this knowledge as a form of distant supervision. We estimate the mean position for each TP using the gold standard annotation of the plot synopses in our training set (normalized by the synopsis length). The results are shown in Table 3, together with the TP positions postulated by screenwriting theory. We observe that our estimates agree well with the theoretical predictions, but also that some TPs (e.g., TP2 and TP3) are more variable in their position than others (e.g., TP1 and TP5). This leads us to the following hypothesis: each TP is situated within a specific window in a screenplay. Scenes that lie within the window are semantically related to the TP, whereas all other scenes are unrelated. In experiments we calculate a window $\mu \pm \sigma$ based on our data (see Table 3).

We compute scene representations based on the sequence of sentences that comprise it using a BiLSTM equipped with an attention mechanism (see Section 4.1). The final scene representation s is the weighted sum of the representations of the scene sentences. Next, the TP–scene interaction layer enriches scene representations with similarity values with each marked TP synopsis sentence tp as shown in Equations (5)–(7).

We again augment the above-described base model with contextualized sentence and scene representations using a synopsis and screenplay encoder. The synopsis encoder is the same one used for our sentence-level TP prediction task (see Section 4.1). The screenplay encoder works in a sim-

ilar fashion over scene representations.

Topic-Aware Model (TAM) TAM enhances our screenplay encoder with information about topic boundaries. Specifically, we compute the representations of the left lc_i and right rc_i context window of the i^{th} scene in the screenplay as described in Section 4.1. Next, we compute the final representation z_i of scene sc_i by concatenating the representations of the context windows lc_i and rc_i and the current scene sc_i : $z_i = [lc_i; sc_i; rc_i]$. There is no need to compute the similarity between scenes and context windows here as we now have goldstandard TP representations in the synopsis and employ the TP-scene interaction layer for the computation of the similarity between TPs and enriched scene representations z_i . Hence, we directly calculate in this layer a scene-level feature vector that encodes information about the scene, its similarity to TP sentences, and whether these function as boundaries between topics in the screenplay.

Entity-Specific information We can also employ an entity-specific encoder (see Section 4.1) for the representing the synopsis and scene sentences. Again, generic and entity-specific representations are combined via concatenation.

4.3 End-to-end TP Identification

Our ultimate goal is to identify TPs in screenplays without assuming any goldstandard information about their position in the synopsis. We address this with an end-to-end model which first predicts the sentences that act as TPs in the synopsis (e.g., TAM in Section 4.1) and then feeds these predictions to a model which identifies the corresponding TP scenes (e.g., TAM in Section 4.2).

5 Experimental Setup

Training We used the Universal Sentence Encoder (USE; Cer et al. 2018) as a pre-trained sentence encoder for all models and tasks; its performance was superior to BERT (Devlin et al., 2018) and other related pre-trained encoders (for more details, see the Appendix). Since the binary labels in both prediction tasks are imbalanced, we apply class weights to the loss function of our models. We weight each class by its inverse frequency in the training set (for more implementation details, see the Appendix).

Inference During inference in our first task (i.e., identification of TPs in synopses), we select one sentence per TP. Specifically, we want to track

	TA	D
Baseline	31.00	9.65 (4.41)
CAM	33.00	7.44 (8.09)
TAM	36.00	7.11 (7.98)
+ TP views	39.00	6.52 (7.72)
+ entities	38.00	6.91 (7.65)

(a) Development set

	TA	D
Random	2.00	37.79 (25.33)
Theory baseline	22.00	7.47 (6.75)
Distribution baseline	28.00	7.28 (6.23)
TAM	34.67	6.80 (5.19)
+ TP views	38.57	7.47 (7.48)
+ entities	41.33	7.30 (7.21)
Human agreement	64.00	4.30 (3.43)

(b) Test set

Table 4: Identification of TPs in plot synopses; results are shown in percent (TA: mean Total Agreement; D: annotation distance; standard deviation in brackets).

TAM	TP1	TP2	TP3	TP4	TP5
+ TP views	6.09	9.45	10.72	6.91	4.26
+ entities	7.18	9.35	9.86	5.23	3.48
Human agreement	3.33	5.00	10.58	1.07	1.53

Table 5: Mean annotation distance D (test set); results are shown per TP on the synopsis identification task.

the five sentences with the highest posterior probability of being TPs and sequentially assign them TP labels based on their position. However, it is possible to have a cluster of neighboring sentences with high probability, even though they all belong to the same TP. We therefore constrain the sentence selection for each TP within the window of its expected position, as calculated in the distribution baseline (Section 4.2).

For models which predict TPs in screenplays, we obtain a probability distribution over all scenes in a screenplay indicating how relevant each is to the TPs of the corresponding plot synopsis. We find the peak of each distribution and select a neighborhood of scenes around this peak as TP-relevant ones. Based on the goldstandard annotation, each TP corresponds to 1.77 relevant scenes on average (StDev 1.23). We therefore consider a neighborhood of three relevant scenes per TP.

6 Results

TP Identification in Synopses Table 4a reports our results on the development set (we extracted 20 movies from the original training set) which aim at comparing various model instantiations for the TP identification task. Specifically, we report the performance of a baseline model which is nei-

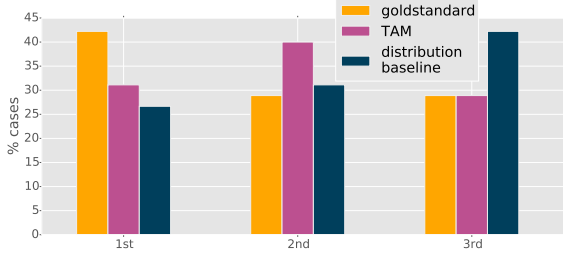


Figure 4: Rankings (shown as proportions) of synopsis highlights produced by aggregating goldstandard TP annotations, those predicted by the distribution baseline, and our model (TAM + TP views).

ther context-aware nor utilizes topic boundary information against CAM and TAM. We also show two variants of TAM enhanced with TP-specific encoders (+ TP views) and entity-specific information (+ entities). Model performance is measured using the evaluation metrics of Total Agreement (TA) and annotation distance (D), normalized by synopsis length (equation (1)).

The baseline model presents the lowest performance among all variants which suggests that state-of-the-art sentence representations on their own are not suitable for our task. Indeed, when contextualizing the synopsis sentences via a BiLSTM layer we observe an absolute increase of 4.00% in terms of TA . Moreover, the addition of a context interaction layer (see TAM row in Table 4a) yields an absolute TA improvement of 4.00% compared to CAM. Combining different TP views further improves by 3.00%, reaching a TA of 39.00%, and reducing D to 6.52%.

Table 4b shows our results on the test set. We compare TAM, our best performing model against two strong baselines. The first one selects sentences that lie on the expected positions of TPs according to screenwriting theory; while the second one selects sentences that lie on the peaks of the empirical TP distributions in the training set (Section 4.2). As we can see, TAM (+ TP views) achieves a TA of 38.57% compared to 22.00% for the distribution baseline. And although entity-specific information does not have much impact on the development set, it yields a 2.76% improvement on the test set. A detailed break down of results per TP is given in Table 5. Interestingly, our model resembles human behavior (see row *Human agreement*): TPs 1, 4, and 5 are easiest to distinguish, whereas TPs 2 and 3 are hardest and frequently placed at different points in the synopsis.

We also conducted a human evaluation experi-

	TA	PA	D
Theory baseline	8.66	10.67	10.45 (9.14)
Distribution baseline	6.67	9.33	10.84 (8.94)
tf*idf similarity	0.74	1.33	53.07 (31.83)
tf*idf + distribution	4.44	6.67	13.33 (11.51)
CAM	11.11	16.00	10.23 (11.23)
+ entities	14.18	17.33	12.77 (12.61)
TAM	10.63	13.33	8.94 (9.39)
+ entities	10.63	13.33	10.15 (10.56)
TAM End2end	7.87	9.33	10.16 (10.74)
<i>Human agreement</i>	35.48	56.67	1.48 (2.93)

Table 6: Identification of TPs in screenplays; results are shown in percent using five-fold cross validation (TA : mean Total Agreement; PA : Partial Agreement; D : annotation distance D ; standard deviation in brackets).

ment on Amazon Mechanical Turk (AMT). AMT workers were presented with a synopsis and “highlights”, i.e., five sentences corresponding to TPs. We obtained highlights from goldstandard annotations, the distribution baseline, and TAM (+ TP views). AMT workers were asked to read the synopsis and rank the highlights from best to worst according to the following criteria: (1) the quality of the plotline that they form; (2) whether they include the most important events and plot twists of the movie; and (3) whether they provide some description of the events in the beginning and end of the movie. In Figure 4 we show, proportionally, how often our participants ranked each model 1st, 2nd, and so on. Perhaps unsurprisingly, goldstandard TPs were considered best (and ranked 1st 42% of the time). TAM is ranked best 30% of the time, followed by the distribution baseline which was only ranked first 26% of the time. Overall, the average ranking positions for the goldstandard, TAM, and the baseline are 1.87, 1.98, and 2.16, respectively. Human evaluation therefore validates that our model outperforms the position-based baselines.

TP Identification in Screenplays Our results are summarized in Table 6. For this task, we performed five-fold crossvalidation over our original goldstandard set to obtain a test-development split (recall we do not have goldstandard annotations for training). We report Total Agreement (TA), Partial Agreement (PA), and annotation distance D , normalized by screenplay length (Equations (2)–(4)).

Aside from the theory and distribution-based baselines, we also experimented³ with a com-

³Common segmentation approaches such as TextTiling (Hearst, 1997) perform poorly on our task and we do not report them due to space constraints.

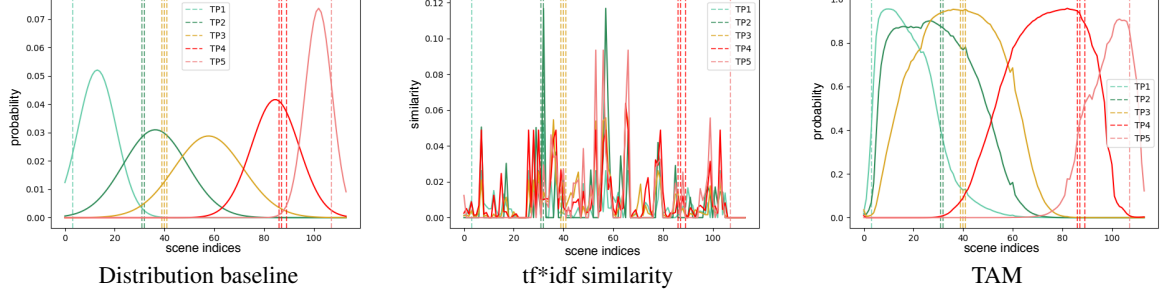


Figure 5: Probability distributions over the scenes of the screenplay for the movie “Juno”; x-axis: scene indices, y-axis: probability that the scene is relevant to a specific TP. Vertical dashed lines are goldstandard TP scenes.

mon IR baseline which considers TP synopsis sentences as queries and retrieves a neighborhood of semantically similar scenes from the screenplay using tf*idf similarity. Specifically, we compute the maximum tf*idf similarity for all sentences included in the respective scene. We empirically observed that tf*idf’s behavior can be erratic selecting scenes in completely different sections of the screenplay, and therefore constrain it by selecting scenes only within the windows determined by the position distributions ($\mu \pm \sigma$) for each TP. As far as our own models are concerned, we report results with goldstandard TP labels for CAM and TAM on their own and enriched with entity information. We also built an end-to-end system based on TP predictions from TAM.

As can be seen in Table 6, tf*idf approaches perform worse than position-related baselines. Overall, similar vocabulary across scenes and mentions of the same entities throughout the screenplay make tf*idf approaches insufficient for our tasks. The best performing model is TAM confirming our hypothesis that TPs are not just isolated key events, but also mark boundaries between thematic units and, therefore, segmentation-inspired approaches can be beneficial for the task. Results for entities are somewhat mixed; for CAM, the entity-specific information improves *TA* and *PA* but increases *D*, while it does not seem to make much difference for TAM. The performance of the end-to-end TAM model drops slightly compared to the same model using goldstandard TP annotations. However, it still remains competitive against the baselines, indicating that tracking TPs in screenplays fully automatically is feasible.

In Figure 5, we visualize the posterior distribution of various models over the scenes of the screenplay for the movie “Juno”. The first panel shows the distribution baseline alongside goldstandard TP scenes (vertical lines). We observe

that the distribution baseline provides a good approximation of relevant TP positions (which validates its use in the construction of noisy labels, Section 4.2), even though it is not always accurate. For example, TPs 1 and 3 lie outside the expected window in “Juno”.

The second panel presents the TP predictions according to tf*idf similarity. We observe that scenes located in entirely different parts of the screenplay present high similarity scores with respect to a given TP due to vocabulary uniformity and mentions of the same entities throughout the screenplay. In the next panel we present the predictions of TAM. Adding synopsis and screenplay encoders yields smoother distributions increasing the probability of selecting TP scenes inside distinct regions of the screenplay, with sharper peaks and higher confidence.

7 Conclusions

We proposed the task of turning point identification in screenplays as a means of analyzing their narrative structure. We demonstrated that automatically identifying a sequence of key events and segmenting the screenplay into thematic units is feasible via an end-to-end neural network model. In future work, we will investigate the usefulness of TPs for summarization and question answering. We will also scale the TRIPOD dataset and move to a multi-modal setting where TPs are identified directly in video data.

Acknowledgments

We thank the anonymous reviewers for their feedback. We gratefully acknowledge the support of the European Research Council (Lapata; award 681760, “Translating Multiple Modalities into Text”) and of the Leverhulme Trust (Keller; award IAF-2017-019).

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A Model Details

Synopsis Encoder In all tasks we use a synopsis encoder in order to contextualize the sentences in the synopsis. We employ an LSTM network as the synopsis encoder which produces sentence representations h_1, h_2, \dots, h_T , where h_i is the hidden state at time-step i , summarizing all the information of the synopsis up to the i -th sentence. We use a Bidirectional LSTM (BiLSTM) in order to get sentence representations that summarize the information from both directions. A BiLSTM consists of a forward LSTM \vec{f} that reads the synopsis from p_1 to p_N and a backward LSTM \overleftarrow{f} that reads it from p_N to p_1 . We obtain the final representation cp_i for a given synopsis sentence p_i by concatenating the representations from both directions, $cp_i = h_i = [\vec{h}_i; \overleftarrow{h}_i]$, $h_i \in \mathbb{R}^{2S}$, where S denotes the size of each LSTM.

Entity-Specific Encoder This encoder is used to evaluate the contribution of entity-specific information to the performance of our models. We use a word embedding layer to project words w_1, w_2, \dots, w_T of the i^{th} synopsis sentence p_i to a continuous vector space \mathbb{R}^E , where E the size of the embedding layer. This layer is initialized with pre-trained entity embeddings. Next, we use a BiLSTM as described in the case of the synopsis encoder. On top of the LSTM, we add an attention mechanism, which assigns a weight a_i to each word representation h_i . We compute the entity-specific representation pe_i of the i^{th} plot sentence as the weighted sum of word representations:

$$e_j = \tanh(W_h h_j + b_h), \quad e_j \in [-1, 1] \quad (8)$$

$$a_j = \frac{\exp(e_j)}{\sum_{t=1}^T \exp(e_t)}, \quad \sum_{j=1}^T a_j = 1 \quad (9)$$

$$pe_i = \sum_{j=1}^T a_j h_j, \quad e \in \mathbb{R}^{2S} \quad (10)$$

where W_h and b_h are the attention layer’s weights.

B Implementation Details

Pre-trained Sentence Encoder The performance of our models depends on the initial sentence representations. We experimented with using the large BERT model (Devlin et al., 2018) and the Universal Sentence Encoder (USE) (Cer et al., 2018) as pre-trained sentence encoders in all tasks. Intuitively, we expect USE to be more suitable, since it was trained in textual similarity tasks which are more relevant to ours. Experiments on the development set confirmed our intuition. Specifically, on the screenplay TP prediction task, annotation distance D dropped from 17.00% to 10.04% when employing USE instead of the BERT embeddings in the CAM version of our architecture.

Hyper-parameters We used the Adam algorithm (Kingma and Ba, 2014) for optimizing our networks. After experimentation, we chose an LSTM with 32 neurons (64 for the BiLSTM) for the synopsis encoder in the first task and one with 64 neurons for the encoder in the second task. For the context interaction layer, the window l was set to two sentences for the first task and 20% of the screenplay length for the second task. For the entity encoder, an embedding layer of size 300 was initialized with the Wikipedia2Vec pre-trained word embeddings (Yamada et al., 2018) and remained frozen during training. The LSTM of the encoder had 32 and 64 neurons for the first and second tasks, respectively. Finally, we also added a dropout of 0.2. For developing our models we used PyTorch (Paszke et al., 2017).

Data Augmentation We used multiple annotations for training for movies where these were available and considered reliable. The reasons for this are twofold. Firstly, this allowed us to take into account the subjective nature of the task during training; and secondly, it increased the size of our dataset, which contains a limited number of movies. Specifically, we added triplicate annotations for 17 movies and duplicate annotations for 5 movies.

C Example Output: TP Identification in Synopses

As mentioned in Section 6, we also conducted a human evaluation experiment, where highlights were extracted by combining the five sentences labeled as TPs the synopsis. In Tables 7, 8, and 9,

Goldstandard
<ul style="list-style-type: none"> • Sixteen-year-old Minnesota high-schooler Juno MacGuff discovers she is pregnant with a child fathered by her friend and longtime admirer, Paulie Bleeker. • All of this decides her against abortion, and she decides to give the baby up for adoption. • With Mac, Juno meets the couple, Mark and Vanessa Loring (Jason Bateman and Jennifer Garner), in their expensive home and agrees to a closed adoption. • Juno watches the Loring marriage fall apart, then drives away and breaks down in tears by the side of the road. • Vanessa comes to the hospital where she joyfully claims the newborn boy as a single adoptive mother.
TAM (+ TP views)
<ul style="list-style-type: none"> • Going to a local clinic run by a women’s group, she encounters outside a school mate who is holding a rather pathetic one-person Pro-Life vigil. • With Mac, Juno meets the couple, Mark and Vanessa Loring (Jason Bateman and Jennifer Garner), in their expensive home and agrees to a closed adoption. • Juno and Leah happen to see Vanessa in a shopping mall being completely at ease with a child, and Juno encourages Vanessa to talk to her baby in the womb, where it obligingly kicks for her. • Juno watches the Loring marriage fall apart, then drives away and breaks down in tears by the side of the road. • The film ends in the summertime with Juno and Paulie playing guitar and singing together, followed by a kiss.
Distribution baseline
<ul style="list-style-type: none"> • Once inside, however, Juno is alienated by the clinic staff’s authoritarian and bureaucratic attitudes. • Juno visits Mark a few times, with whom she shares tastes in punk rock and horror films. • Not long before her baby is due, Juno is again visiting Mark when their interaction becomes emotional. • Juno then tells Paulie she loves him, and Paulie’s actions make it clear her feelings are very much reciprocated. • Vanessa comes to the hospital where she joyfully claims the newborn boy as a single adoptive mother.

Table 7: Highlights for the movie "Juno": goldstandard annotations and predicted TPs for TAM (+ TP views) and distribution baseline.

we present the highlights presented to the AMT workers for the movies "Juno", "Panic Room", and "The Shining", respectively. For each movie we show the goldstandard annotations alongside with the predicted TPs for TAM (+ TP views) and the distribution baseline, which is the strongest performing baseline with respect to the automatic evaluation results.

Overall, we observe that goldstandard highlights describe the plotline of the movie, contain a first introductory sentence, some major and intense events, and a last sentence that describes the ending of the story.

The distribution baseline is able to predict a few goldstandard TPs by only considering the relative position of the sentences in the synopsis. This observation validates the screenwriting theory: TPs, or more generally important events that determine the progression of the plot, are consistently distributed in specific parts of a movie. However, when the distribution baseline cannot predict the exact TP sentence, it might select one that describes irrelevant events of minor importance (e.g., TP4 for "Panic Room" is a detail about a secondary character instead of a major setback and highly intense event in the movie).

Finally, our own model seems to be able to predict some goldstandard TP sentences, as demonstrated during the automatic evaluation. However, we also observe here that even when it does not select the goldstandard TPs, the predicted ones

describe important events in the movie that have some desired characteristics. In particular, for the movie "Juno" the climax (TP5) is the moment of resolution, where Vanessa decides to adopt the baby after all the setbacks and obstacles. Even though our model does not predict this sentence, it does select one that reveals information about the ending of the movie. An other such example is the movie "Panic Room", where the point of no return (TP3) is not correctly predicted, but the selected sentence refers to the same event.

Goldstandard
<ul style="list-style-type: none"> • On the night the two move into the home, it is broken into by Junior, the previous owner's grandson; Burnham, an employee of the residence's security company; and Raoul, a ski mask-wearing gunman recruited by Junior. • Before the three can reach them, Meg and Sarah run into the panic room and close the door behind them, only to find that the burglars have disabled the telephone. • To make matters worse, Sarah, who has diabetes, suffers a seizure. • Sensing the potential danger to her daughter, Meg lies to the officers and they leave. • After a badly injured Stephen shoots at Raoul and misses, Raoul disables him and prepares to kill Meg with the sledgehammer, but Burnham, upon hearing Sarah's screams of pain, returns to the house and shoots Raoul dead, stating, "You'll be okay now", to Meg and her daughter before leaving.
TAM (+ TP views)
<ul style="list-style-type: none"> • On the night the two move into the home, it is broken into by Junior, the previous owner's grandson; Burnham, an employee of the residence's security company; and Raoul, a ski mask-wearing gunman recruited by Junior. • Before the three can reach them, Meg and Sarah run into the panic room and close the door behind them, only to find that the burglars have disabled the telephone. • Her emergency glucagon syringe is in a refrigerator outside the panic room. • As Meg throws the syringe into the panic room, Burnham frantically locks himself, Raoul, and Sarah inside, crushing Raoul's hand in the sliding steel door. • After a badly injured Stephen shoots at Raoul and misses, Raoul disables him and prepares to kill Meg with the sledgehammer, but Burnham, upon hearing Sarah's screams of pain, returns to the house and shoots Raoul dead, stating, "You'll be okay now", to Meg and her daughter before leaving.
Distribution baseline
<ul style="list-style-type: none"> • On the night the two move into the home, it is broken into by Junior, the previous owner's grandson; Burnham, an employee of the residence's security company; and Raoul, a ski mask-wearing gunman recruited by Junior. • Unable to seal the vents, Meg ignites the gas while she and Sarah cover themselves with fireproof blankets, causing an explosion which vents into the room outside and causes a fire, injuring Junior. • To make matters worse, Sarah, who has diabetes, suffers a seizure. • While doing so, he tells Sarah he did not want this, and the only reason he agreed to participate was to give his own child a better life. • As the robbers attempt to leave, using Sarah as a hostage, Meg hits Raoul with a sledgehammer and Burnham flees.

Table 8: Highlights for the movie "Panic Room": goldstandard annotations and the predicted TPs for TAM (+ TP views) and distribution baseline.

Goldstandard
<ul style="list-style-type: none"> • Manager Stuart Ullman warns him that a previous caretaker developed cabin fever and killed his family and himself. • Hallorann tells Danny that the hotel itself has a "shine" to it along with many memories, not all of which are good. • After she awakens him, he says he dreamed that he had killed her and Danny. • Jack begins to chop through the door leading to his family's living quarters with a fire axe. • Wendy and Danny escape in Hallorann's snowcat, while Jack freezes to death in the hedge maze.
TAM (+TP views)
<ul style="list-style-type: none"> • Jack's wife, Wendy, tells a visiting doctor that Danny has an imaginary friend named Tony, and that Jack has given up drinking because he had hurt Danny's arm following a binge. • Hallorann tells Danny that the hotel itself has a "shine" to it along with many memories, not all of which are good. • Danny starts calling out "redrum" frantically and goes into a trance, now referring to himself as "Tony". • When Wendy sees this in the bedroom mirror, the letters spell out "MURDER". • Wendy and Danny escape in Hallorann's snowcat, while Jack freezes to death in the hedge maze.
Distribution baseline
<ul style="list-style-type: none"> • Jack's wife, Wendy, tells a visiting doctor that Danny has an imaginary friend named Tony, and that Jack has given up drinking because he had hurt Danny's arm following a binge. • Jack, increasingly frustrated, starts acting strangely and becomes prone to violent outbursts. • Jack investigates Room 237, where he encounters the ghost of a dead woman, but tells Wendy he saw nothing. • When Wendy sees this in the bedroom mirror, the letters spell out "MURDER". • He kills Hallorann in the lobby and pursues Danny into the hedge maze.

Table 9: Highlights for the movie "The Shining": goldstandard annotations and the predicted TPs TAM (+ TP views) and distribution baseline.